

Special Standards

Roanoke River Manganese

- Roanoke River assigned PWS designation from Kerr to Leesville dam
- Manganese secondary MCL (50 ug/l) applies at WTP intake
- Naturally higher than 50 ug/l
- If background > 50 ug/L then discharge limit = 50 ug/L.
- Impacted permittee 20+ miles upstream of WTP intake

Manganese

What concentrations are of concern?

- Virginia's current PWS Criterion (50 ug/L)
 - Basis EPA's SMCL
 - Consumer complaints (staining of laundry and objectionable tastes in beverages) arise when manganese exceeds a concentration of 150 ug/L in water supplies (Griffin, 1960).
- EPA Drinking Water Health Advisory (300 ug/L)
 - Published January, 2004
 - Lifetime value for adults: 10-day advisory for children < 6 months
 - Non-regulatory, non-enforceable
 - Substantial data support neurological effects of inhaled manganese
 - Few data for association between oral exposure and toxic effects.

Aquatic Life Protection

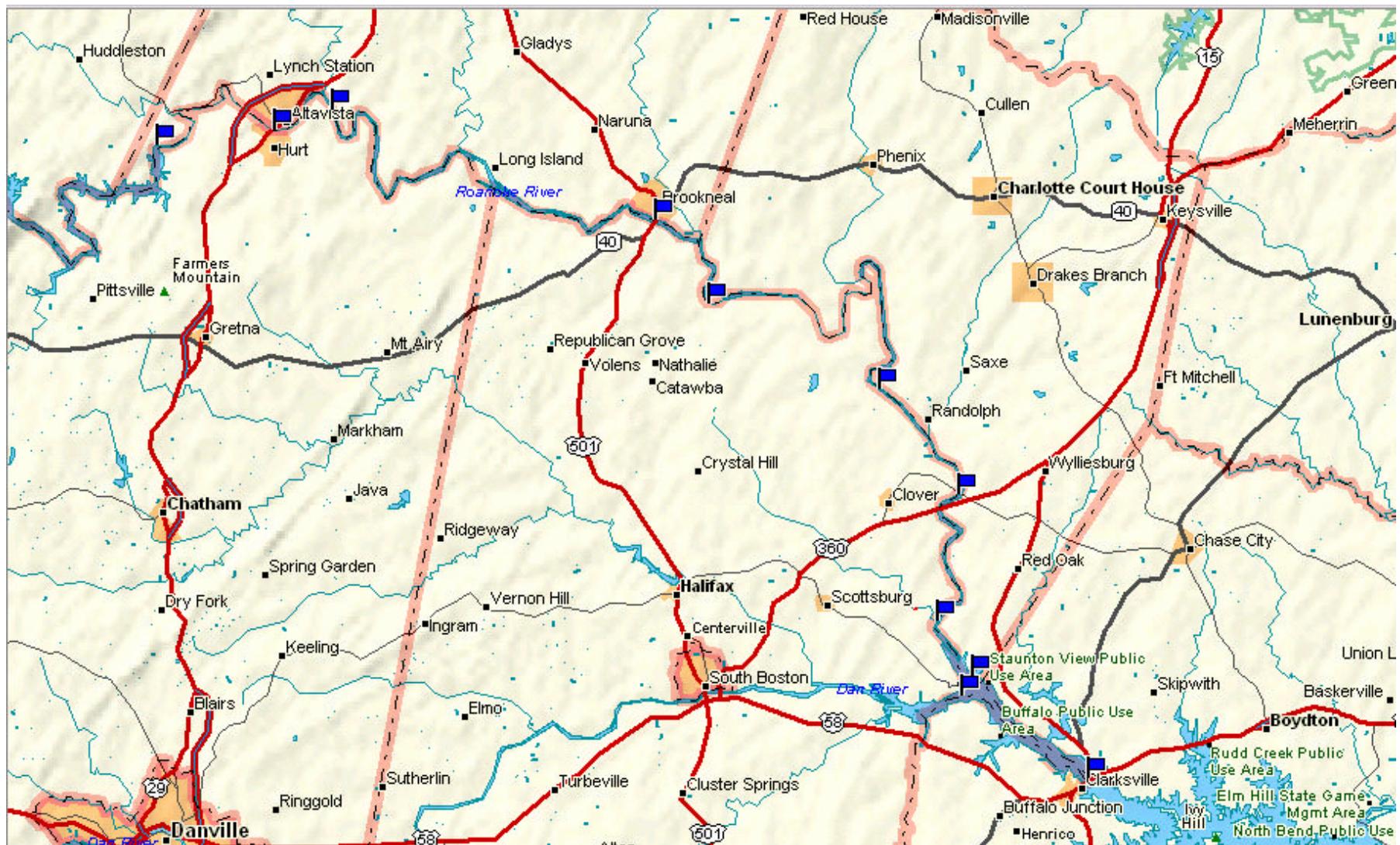
- No existing EPA aquatic life criteria
- Stubblefield *et al* (1997); Lasier *et al* (2000)
 - Toxicity hardness dependent
 - Toxicity occurs > several mg/L manganese
- Colorado hardness-based dissolved aquatic life criteria (hardness 48.2 mg/L as CaCO₃):
 - Acute = 2.34 mg/L
 - Chronic = 1.30 mg/L

Clover Power Station

- 850 megawatt coal-fired station
- Located in Halifax County near Clover
- Several VPDES permitted discharges to Roanoke (Staunton) River
- 50 ug/L manganese limit on Outfall 009 (effective date 12/31/09).
- Clarksville closest PWS intake (~ 20 miles downstream).



Roanoke (Staunton) River



Roanoke River at Randolph



Manganese Site-Specific Standard Investigation

- Determine background surface water Mn concentrations.
- Measure Mn in intake and finished water at nearest WTP.
- Determine site-specific manganese standard protective for WTP and other beneficial uses.

Total (T) and Dissolved (D) Manganese (mg/L): Kerr Reservoir, Roanoke River, Dan River

Summary Statistic	Kerr Reservoir		Roanoke River		Dan River	
	D	T	D	T	D	T
Mean	0.019	0.047	0.021	0.067	0.131	0.077
Median	0.020	0.030	0.020	0.052	0.114	0.050
St dev	0.006	0.037	0.019	0.046	0.034	0.086
25%	0.020	0.030	0.007	0.040	0.110	0.027
75%	0.020	0.070	0.023	0.080	0.170	0.100
Minimum	0.001	0.011	0.004	0.010	0.110	0.005
Maximum	0.030	0.160	0.083	0.234	0.170	0.690
N	23	31	20	73	3	100

Clarksville WTP

Date	Raw Water			Finished Water		
	Manganese (mg/L)			Manganese (mg/L)		
	Time	Total	Dissolved	Time	Total	Dissolved
09/07/06	1040	0.07	0.03	1042	0.04	<0.02
09/11/06	0650	0.03	<0.02	0650	0.03	<0.02
09/12/06	1145	0.03	<0.02	1145	0.06	<0.02
09/15/06	0641	0.04	<0.02	0640	0.04	<0.02
09/20/06	0622	0.02	<0.02	0620	0.02	<0.02
09/21/06	1545	0.03	<0.02	1545	<0.02	<0.02
09/22/06	0600	0.04	<0.02	0602	0.03	<0.02
09/25/06	1030	0.04	<0.02	1040	<0.02	<0.02
09/27/06	0645	0.03	<0.02	0640	0.02	<0.02
09/29/06	1400	0.02	<0.02	1410	<0.02	<0.02
10/03/06	0650	0.04	<0.02	0652	0.04	0.04
10/04/06	0638	0.03	<0.02	0636	0.03	0.03
10/10/06	0628	0.05	<0.02	0625	<0.02	<0.02
10/13/06	0600	0.02	<0.02	0610	0.03	<0.02
10/18/06	0615	0.03	<0.02	0618	<0.02	<0.02

Manganese Data Summary

- Dan > Roanoke > Kerr Reservoir
- Dan & Roanoke:
 - Dissolved & Total >50 ug/L.
- Kerr Reservoir:
 - Total > 50 ug/L, Dissolved < 50 ug/L
- Clarksville WTP (Raw Water)
 - Total < 70 ug/L, Dissolved < 50 ug/L

Relative Manganese Loadings

	Total Manganese (mg/L)**	Average Daily Flow (MGD)*	Average Daily Loading (lbs/d)	% of Total
Dan River	0.085	1823	1293	53
Roanoke River	0.068	1978	1122	46
Outfall 009	65	0.08	43	2

*Flows for Dan River and Roanoke River taken from USGS guage data for Pace and Randolph VA, Respectively

**Total manganese concentrations for Dan & Roanoke Rivers are average concentrations. The total manganese concentration for Outfall 009 is the maximum predicted discharge concentration. Current concentration ~ 8 mg/L.

Manganese Criteria Options for Consideration

- Delete current 50 ug/L criterion.
- Delete current criterion and apply 300 ug/L health advisory at WTP intake.
- Define form of existing criterion as dissolved manganese.
- Apply 50 ug/l dissolved criterion at WTP intake, and 300 ug/L criterion at mouth of Roanoke River.